ANTS FROM NORTHERN ARIZONA AND SOUTHERN UTAH

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Abstract.— Ants of 22 species were collected in can pit-traps from 16 different vegetative associations to determine distribution, seasonal and annual occurrence, and population as bases for monitoring environmental impact. Thirteen species were sufficiently abundant and distributed to qualify as indicator species. *Myrmecocystus mexicanus* was the most widespread ecologically. *Pogonomyrmex occidentalis* was the most abundant species, but second in ecological distribution. The greatest number of species was found in the juniper-*Ephedra*-grass association, and the fewest species in *Ephredra-Coleogyne-Grayia*.

In June 1971, ecological studies were initiated by the Center of Health and Environmental Studies at Brigham Young University to establish baselines to determine the environmental impact of the Navajo Generating Station near Page, Arizona, and the proposed Kaiparowits Generating Station in Kane County in southern Utah.[3] Field studies of arthropods were conducted from July to September in 1971, and from May to August in 1972 and 1973. Of the 12 sites operated in 1971, the 16 in 1972, and the 12 in 1973, some were studied only one year, others two, and some all three years.

The trapping method, study sites, and predominant vegetation on each site are described by Allred and Tanner (1971, Great Basin Nat. 39:89–96). The ants were identified by Arthur C. Cole

Species Commonly Collected

Camponotus vicinus Mayr is common and widespread in the arid and semiarid western United States. Nesting generally beneath stones and logs, it is a strong and highly successful contender for space and food.

One specimen was taken at site 1, 106 at site 2, 27 at site 6, 54 at site 19, 41 at site 27, and 5 at site 28. Largest numbers were taken at site 19, a *Coleogyne* community. Ants were taken from July to September in 1971, most abundantly during the latter two months; April to September in 1972, most abundantly in August; and May to August in 1973, also most abundantly in August. Comparison of July and August collections for the three years showed twice as much activity in 1972 and 1973 than in 1971. For the period of May to August, only slightly more activity was noted in 1972 than in 1973.

Conomyrma insana (Buckley), known previously as *Dorymyrmex pyramicus* (Roger), has circular and semicircular crater mounds that are characteristic components of desert and semidesert regions, and the agile workers run rapidly over the soil in great numbers during their diurnal foraging.

One of the most common species of ants collected, 238 specimens were taken from 14 of the 19 sites. Largest numbers were found on site 27, a juniper-pinyon community. Ants were found in July and August of 1971, most abundantly in July; from May to September of 1972, most abundantly in August; and from May to August of 1973, also most abundantly in August. Comparison of July and August for the three years showed about equal numbers of ants in 1971 and 1972, but only one-fifth as many in 1973. For the period of May to August, four times as many ants were taken in 1972 than in 1973.

Crematogaster depilis Wheeler forms large colonies beneath stones or in nests marked by irregular craters of soil.

Of the total 192 specimens taken from 11 sites, the largest numbers were found on sites 1 and 2, *Ephedra-Vanclevea*-grass and juni-

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per-*Ephedra*-grass communities, respectively. In 1971, ants were found in July and August, more abundantly in August; in April and from June to August in 1972, most abundantly in July; and in May, June, and August of 1973, most abundantly in May. In July and August of the three years, twice as many ants were taken in 1971 than in 1972, and 18 times as many as in 1973.

Formica obtusopilosa Emery nests in dry, sunny areas of rather coarse soil. The large entrance is surrounded by an irregular array of pebbles. Workers forage rapidly over the insolated soil surface.

Forty-one specimens were taken at site 3, an *Ephedra*-grass community, and 18 at site 28, an *Artemisia*-grass community. The apparent absence of this species in other areas is unusual. Ants were taken in 1971 in July and August, predominantly in July; in 1972 from June to September in about equal numbers each month; and in about equal numbers from May to August in 1973. Activity for July and August in 1971 was about equal to the same months of 1972, but about five times greater than in 1973. For the period of May to August, four times as many ants were taken in 1972 than in 1973.

Formica rufibarbis gnava Buckley forms rather large colonies in earthen nests generally marked by an irregular crater or mound.

Seventy-one specimens were taken at site 2, a juniper-*Ephedra*-grass community, and 7 specimens at site 3, an *Ephedra*-grass habitat. All but one of the specimens were taken in 1971, mostly during July. Only one specimen was taken in 1973, in May.

Iridomyrmex pruinosum (E. Andre) is a successful and common component of the desert and semidesert biota. Although it often constructs small circular or irregular craters of fine soil particles, it frequently nests beneath stones and debris. Workers forage rapidly in files even when the soil surface has a high temperature.

Ants were taken from eight sites. More were taken from site 6, an *Artemisia* community, than from any other site. They were found only in August of 1971, and from June to August in 1972.

Monomorium minimum (Buckley) is a minute ant that nests beneath stones and detritus, or in open soil with or without a crater. It forms populous colonies.

Thirty-five specimens were taken from seven sites. Largest numbers were found at site 28, an *Artemisia*-grass community. Ants were taken in August 1971, from May to September in 1972, and only in May of 1973. Most of the specimens in 1972 were taken in July. Thirty-one of the specimens were taken during 1972.

Myrmecocystus mexicanus Wesmael builds nests in unshaded soil. Each nest is usually surmounted by a mound bearing a single, large circular entrance of firmly packed coarse sand. The workers are nocturnal foragers.

Ants of this species were some of the most abundant and the most widespread of all those found. A total of 652 was taken from all 19 sites, the numbers not different significantly from one site to another. They were found during each of the summer months that studies were made. Largest numbers were found in August of 1971, in July and August of 1972, and in May and June of 1973. Comparison of July and August for each of the three years showed about equal numbers in 1971 and 1972, but only one-third as many in 1973. For the period of May to August, half again as many ants were taken in 1972 as in 1973.

Myrmecocystus melliger Forel constructs its nests in rather loose soil marked by a circular or semicircular crater. These ants run rapidly over the ground during their diurnal foraging, and are a conspicuous though familiar element of desert and semidesert areas.

Seventy-one specimens were taken from 12 sites. No significant difference was noted between the numbers of ants at each of the sites. They were taken in July and August of 1971 in about equal numbers; from June to August of 1972, predominantly in July; and in small numbers in May, July, and August of 1973. Comparison of July and August among the three years showed about equal numbers in 1971 and 1972, but only one-fifth as many in 1973. For the period of May to August, four times as many ants were taken in 1972 as in 1973.

Pheidole bicarinata paiute Gregg is a small ant with dimorphic workers that generally nests beneath stones in sand or fine soil. Both

majors and minors forage largely for seeds during the cooler daytime hours.

A total of 198 specimens was taken from 12 sites. Numbers were highest at sites 6 and 28, which were *Artemisia* communities. In 1971, ants were taken from July to September, mostly in August; from May to September in 1972, predominantly in September; and only in June and July of 1973, predominantly in June. Comparison of July and August for the three years showed twice as many in 1971 as in 1972, and 25 times as many as in 1973. For the period of May to August twice as many were taken in 1972 as in 1973.

Pheidole sitarches soritis Wheeler is another dimorphic harvester that constructs small, circular crater nests or sometimes lives beneath stones in unshaded areas.

A total of 110 specimens was taken from 10 sites. Largest numbers were found at site 3, an *Ephedra*-grass community. In 1971 they were found in July and August, mostly July; from June to August in 1972, predominantly in August, and from June to August in 1973, predominantly in June. Comparison of July and August for the three years showed only two-thirds as many in 1972 as in 1971, and only one-fourth as many in 1973. For the period of May to August, numbers were about equal in 1972 and 1973.

Pogonomyrmex occidentalis (Cresson) is a common harvester whose numerous, large, conical or subconical mounds, each surrounded by an area cleared of plants, are some of the most conspicuous features of the desert. The nests are usually in coarse, gravelly soil, and both the underground portion and the superstructure contain chambers and galleries in which brood is raised and seeds are stored.

Ants of this species were the most abundant but not the most widespread of all taken. A total of 800 specimens was taken from 15 of the 19 sites. Ants of the species *Myrmecocystus mexicanus* were more widespread than *P. occidentalis*, but not as abundant. This species was most abundant on site 23, although sites 8, 13, and 14 also had relatively high populations. They were found during each of the summer months that field studies were made. In 1971 and 1972 largest numbers were found in August, and in 1973 in June. Comparison of July and August showed four times as many in 1972 as in 1971, and 13 times as many as in 1973. For the period of May to August, eight times as many were taken in 1972 as in 1973.

Pogonomyrmex rugosus Emery, another large harvester species, constructs nests surmounted by a low gravel mound or disc with a large, irregular central entrance. The workers vigorously defend their nests and sting readily.

Thirty-three specimens were taken from five sites. Largest numbers were found at site 20, a grass community. Only one was taken in 1971 in July, and the balance in about equal numbers from July to September in 1972.

Species Rarely Collected

Camponotus semitestacea Emery: one specimen 6 June 1972, 3 on 6 July 1972, 3 on 5 August 1972, one on 30 April 1973, site 2—juniper-*Ephedra*-grass; 3 on 4 July 1973, site 6—*Artemisia*.

Conomyrma bicolor (Wheeler): 5 specimens 15 August 1972, site 19—*Coleogyne*.

Crematogaster mormonum Emery: 7 specimens on 18, 19 August 1971, site 9—*Atriplex Artemisia*.

Liometopum luctuosum Wheeler: 2 specimens 19 June 1972, site 28—*Artemisia* grass; 12 on 12 May 1973; 15 on 1 July 1973, site 27—juniper-pinyon

Myrmecocystus mimicus Wheeler: 7 specimens on 14, 16 August 1971, site 2—juniper-*Ephedra*-grass; one on 6 June 1972, site 3—*Ephedra*-grass; one on 14 August 1972, site 22—*Coleogyne*.

Pogonomyrmex imberbiculus Wheeler: 3 specimens on 18, 20 August 1971, 2 on 11 August 1972, site 9—*Atriplex-Artemisia*.

Pogonomyrmex subnitidus Emery: 4 specimens 18–20 August 1971, one on 10 April 1972, 2 on 12 July 1972, 3 on 10, 12 August 1972, one on 11 September 1972, site 10—*Ephedra*-grass.

Veromessor lobognathus (Andrews): one specimen 19 August 1971, 2 on 10, 11 August 1972, 2 on 11 September 1972, 6 on 6, 7 June 1973, site 10—*Ephedra*-grass; one on 7 July 1972, site 4—*Coleogyne*; 3 on 12 July 1972, site 8—*Grayia*-grass.

DISCUSSION

These studies were established in major vegetative types within a 48-km perimeter of the proposed sites of the electric generating stations. Retention of study sites beyond the first year was based on vegetative type, direction from the potential source of pollution, and especially the species and relative abundance of organisms present that could be used as indicator species to monitor environmental changes. Some sites were discontinued after one season because of inaccessibility, discontinuous vegetative analysis, and no specific climatic and edaphic data.

In order to compare populations and seasonal changes, the numbers of ants collected were adjusted to the number of trapping attempts. The normal variability in seasonal and annual populations, slightly different trapping periods within the same month, and the influence of periodic and abrupt climatic changes on the activity of the ants during a given trapping period were ignored.

Pit traps are effective primarily for ground-dwelling arthropods that move on the ground more frequently than they fly. The traps involve minimum effort and time, can be used effectively for those species which may be so trapped, and adequately determine relative abundance and distribution within the limitations of time, economy, and logistics. The number of trapping attempts is shown in Table 1.

Thirteen of the 22 species found in this study are sufficiently abundant and distributed that they may be used as indicator species to determine environmental changes (Table 2).

In this study relative numbers of individuals are referred to as "activity," inasmuch as populations were measured only by above-ground activity and not numbers of colonies or individuals within those colonies. An assumption is made that above-ground activity and abundance is directly proportional to the number of colonies and individuals.

Greatest activity of the ants occurred in July and August of 1971 and 1972, and in June of 1973 (Table 3).

The total number of species varied only slightly during the three years (Table 4). Some study sites showed significant variations where data were available for all three years. On 6 of 8 such sites, a decrease in the number of species was noted in 1973. Where only two years' data were available for 5 sites, one site increased in number of species in 1972 over 1971, 3 decreased in 1973 over 1972, and one was equal for 1972 and 1973. Nine of 12 sites showed a species decrease in 1973 over one or both the two previous years.

Table 5 shows the variety of predominant ants for each of the study sites. *Myrmeco-*

TABLE 1. Number of trap-days[1] for pit traps on 16 major study sites, 1971–1973.

Site	1971	1972	1973	Total
1	60	120	90	270
2	60	180	90	330
3	60	180	90	330
4	60	120	*	180
6	60	90	90	240
8	60	90	90	240
10	60	120	90	240
13	60	150	90	300
14	60	150	90	300
19	*	90	*	90
20	*	90	*	90
22	*	150	*	150
23	*	120	90	210
27	*	120	70	190
28	*	120	70	190
30	*	150	90	240
Total	510	2,040	1,040	3,590

[1]Number of traps multiplied by number of days operated.
*Not operated during year indicated.

TABLE 2. Numbers and distribution of ants[1] on 16 major study sites, 1971–1973.

Species	Total number taken	No. sites where found
Pogonomyrmex occidentalis	800	14
Myrmecocystus mexicanus	652	16
Conomyrma insana	238	12
Camponotus vicinus	234	6
Pheidole paiute	198	10
Crematogaster depilis	192	10
Pheidole sitarches	110	9
Formica rufibarbis	78	2
Myrmecocystus melliger	71	11
Formica obtusopilosa	61	2
Monomorium minimum	35	7
Pogonomyrmex rugosus	33	4
Iridomyrmex pruinosum	26	7

[1]Only those species are included of which more than 20 specimens were taken.

TABLE 3. Total number of ants of all species collected in pit traps at 16 major study sites, 1971–1973.

Month	No. ants collected					
	1971		1972		1973	
	Actual	Adjusted[1]	Actual	Adjusted[1]	Actual	Adjusted[1]
April	*		34	54	*	
May	*		46	69	116	151
June	*		266	319	111	266
July	184	736	649	649	88	176
August	424	721	701	841	76	152
September	27	216	96	307	*	

[1]Numbers adjusted to number of trap days.
*Traps not operated.

TABLE 4. Number of species of ants captured in pit traps on 16 major study sites, 1971–1973.

Site	Predominant vegetation	1971	1972	1973	Total
1	*Ephedra-Vanclevea*-Grass	7	8	8	10
2	Juniper-*Ephedra*-Grass	10	9	10	13
3	*Ephedra*-Grass	7	9	4	11
4	*Coleogyne*	4	7	*	7
6	*Artemisia*	7	6	3	8
8	*Grayia*-Grass	5	5	3	6
10	*Ephedra*-Grass	5	8	4	8
13	*Grayia-Ephedra*-Grass	5	7	4	7
14	*Coleogyne-Grayia-Ephedra*-Grass	4	7	4	7
19	*Coleogyne*	*	9	*	9
20	Grass	*	5	*	5
22	*Coleogyne*	*	7	*	7
23	*Ephedra-Coleogyne-Grayia*	*	3	3	3
27	Juniper-Pinyon	*	8	6	9
28	*Artemisia*-Grass	*	8	4	9
30	*Ephedra*-Grass	*	6	2	6
	Total	20	20	16	24

*Not trapped during year indicated.

TABLE 5. Percentage composition[1] of ants on 16 major study sites, 1971–1973.

Site	Species of ant												
	Cam vic	Con ins	Cre dep	For obt	For gna	Mon min	Myr mex	Myr pla	Phe pai	Phe sor	Pog occ	Pog rug	Other[2]
1	*	*	26			*	28	*	18	*	*		(1)
2	26	*	12		18		20	*	*	*	*		(3)
3			14	16	*	*	10	*	14	20	17	*	(1)
4			*			*	41	*		*	38		(1)
6	19						26	*	36		*		(3)
8		*	*			*	23				64		(1)
10		*					51	*		*	22		(3)
13		*	*				14		*	*	69		(1)
14		*	*				24	*	*		63		(1)
19	55	*	*			*	16	*	*			*	
20		27					*	*	*			49	
22		*					53	*	27		*	*	(1)
23			*				27				72		
27	15	34					24	*	*		11		(3)
28	*	15		16		19	*		28	*	*		(1)
30		21	*			*	29			*	43		

[1]The nearest whole percentage is listed for those which constitute at least 10 percent of the specimens collected. However, percentage is relative to all species of ants collected. An asterisk indicates presence in numbers less than 10 percent.
[2]Number in parentheses indicates number of other species present, each one less than 10 percent of the total composition.

cystus mexicanus was on all 16 of the sites evaluated, but not significantly abundant on 2 sites. *Pogonomyrmex occidentalis* was on 14 of the sites, but of significant composition on only 9. Only 2 sites had the same species composition (sites 8 and 30), but the relative percentages of each species differed between them.

Comparison of sites which were most alike in predominant plant species showed some significant differences. *Coleogyne* sites 4, 19, and 22 had only one species of ant in common. Site 4 had three unique species, and site 22 had two unique species. Comparison of sites 14 and 23, which also contained significant amounts of *Coleogyne*, showed both sites with one species common to each and to the other *Coleogyne* sites, both sites with two species common to each and to site 4, and site 14 with one species common to site 22.

Comparison of *Ephedra*-grassland sites 3, 10, and 30 showed only one species common to all three. One species was common to sites 3 and 30, one species to 10 and 30, three species unique to site 3, two to site 10, and one to site 30. Comparison of sites 1 and 20, which also had significant amounts of *Ephedra* and grass, showed one species common to each and to sites 10 and 30, one species common to each and to site 3, one common to each and site 30, site 1 with one species common to sites 3 and 30, and with each site with one unique species.

Artemisia sites 6 and 28 had only one species in common. Three species were unique to site 6, and four species to site 28.

Grayia-grass sites 8 and 13 had three species in common, and each had one unique species.

Juniper woodland sites 2 and 27 had three species in common, site 2 had two unique species, and site 27 one unique species.

Annual differences in species composition varied between the three years. Two species that were active in 1972 and 1973 were not taken in 1971. One species active in 1973 was not taken in the other years, and one species present in 1972 was not taken in the other years. Three species present in 1971 were not taken in 1972 or 1973. One species taken in 1971 and 1973 was not found in 1972, and five species taken in 1971 and 1972 were not taken in 1973.

Relative activity (measured by the number of specimens caught in traps) of individual species differed between years. One species was more active in 1971 than in other years, 10 were most active in 1972, 2 in 1973, and one more active in 1972 and 1973 than in 1971. In years when comparisons could be made for similar months, most species were much more active in 1972 than in 1973. *Camponotus vicinus* was only slightly more active; *Conomyrma insana*, *Formica obtusopilosa*, and *Myrmecocystus melliger* were 4 times as active; *Crematogaster depilis* 3 times as active; *Pheidole paiute* 2 times as active; *Myrmecocystus mexicanus* half again as active; *Pogonomyrmex occidentalis* 8 times as active; and *Monomorium minimum* 33 times as active in 1972 as in 1973. *Pheidole soritis* was about equally active in 1972 and 1973, and *Veromessor lobognathus* was 2 times as active in 1973 as in 1972.

Comparison of the months July and August for the three years showed that *Crematogaster depilis*, *Pheidole paiute*, and *Pheidole soritis* were most active in 1971; *Iridomyrmex pruinosum*, *Monomorium minimum*, *Pogonomyrmex occidentalis*, *P. rugosus*, and *Veromessor lobognathus* in 1972; *Conomyrma insana*, *Formica obtusopilosa*, *Myrmecocystus mexicanus*, *M. placodops*, and *Pogonomyrmex subnitidus* in 1971 and 1972; and *Camponotus vicinus* in 1972 and 1973.